R.I. Shellfish Offer Clue to Health of Chesapeake

By Elizabeth Williamson
Washington Post Staff Writer
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Although 4.5 billion creatures died, the whole thing might have gone unnoticed, except for a couple of Brown University ecologists who dived to the bottom of Rhode Island's Narragansett Bay in the summer of 2001. There they found acres of blue mussels, suffocated by pollution-related oxygen loss in the bay waters.

The grim discovery triggered a study that has given experts new insights into the crucial role that shellfish play in maintaining the health of estuaries worldwide, documenting that reefs of mussels and other shellfish serve as powerful water filters, food sources and habitat for other species.

"What we captured in 2001 was the loss of those mussels and implications for an entire ecosystem," said Brown University ecologist Andrew Altieri, who with biology professor Jon Witman wrote the study published in the March issue of Ecology. "That's instructive for what historic and future losses might be for the Chesapeake."

Rhode Island's Narragansett Bay holds only one-twentieth as much water as the Chesapeake, but both are shallow and relatively slow-flushing, with plenty of people and industry nearby. And both suffer from summer bouts of hypoxia caused when excess nitrogen and phosphorus, chiefly from fertilizer runoff and sewage plants, feed "blooms" of microscopic algae too numerous to be eaten by other creatures. The algae die and decompose in a process that hogs oxygen.

Intense hypoxia, with algae's miles-long blooms, creates massive "dead zones," areas too starved of oxygen to support much life. The United Nations estimates that over the past 15 years, the number of waters harmed by hypoxia has doubled. Last year, about 5 percent of the Chesapeake Bay was classified as a dead zone.

Warm weather, scant wind and heavy rain can all spur hypoxic events. But the biggest factor is the nitrogen-laden spring runoff pouring into estuaries right now.

By the end of May, "you've set things up for the way the summer is going to look," said Dave Jasinski, water quality analyst for the Chesapeake Bay Program. For that reason, this year's spring drought bodes well for the bay, he said.

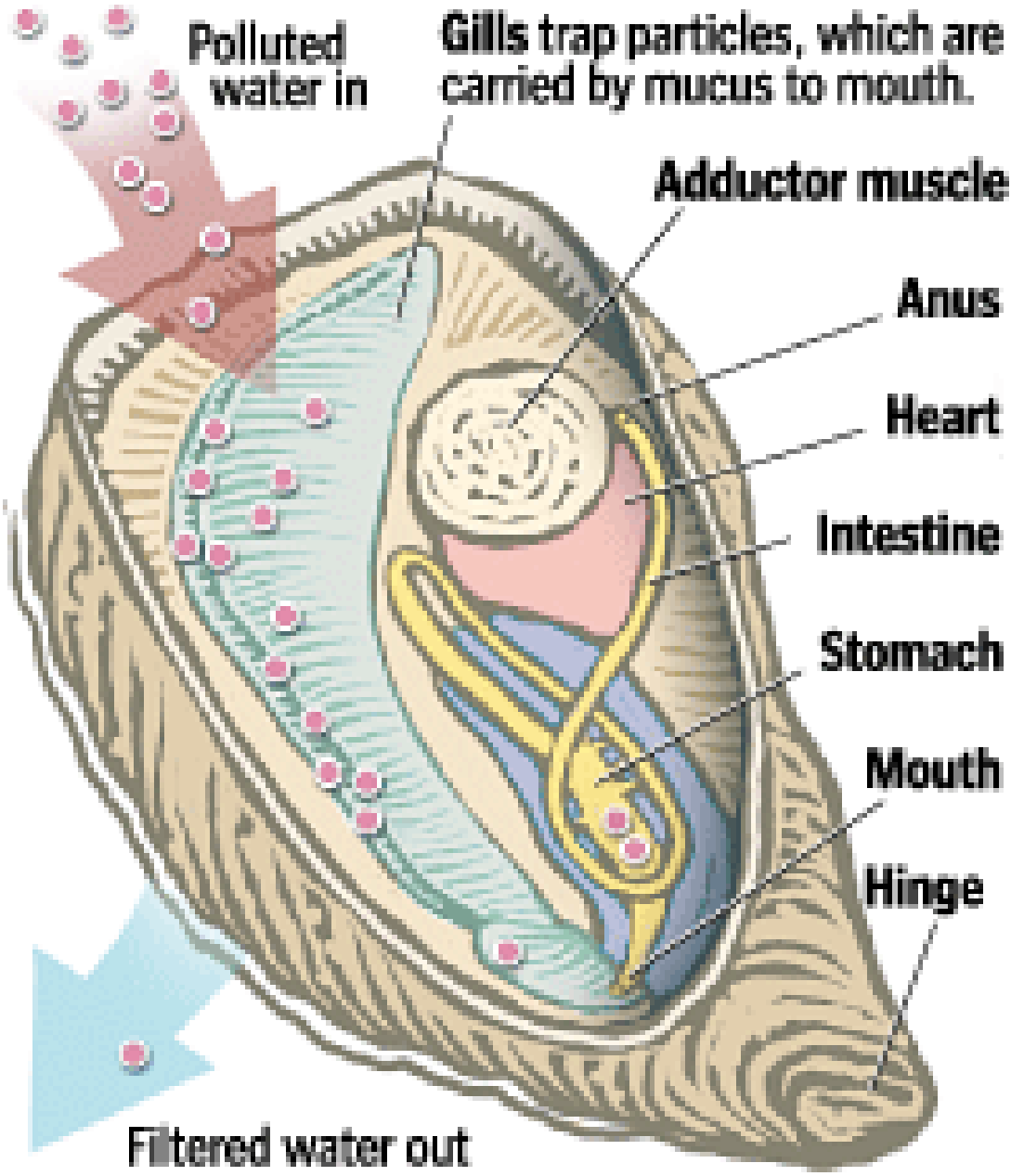
Only radical reductions in nitrogen and phosphorus dumping can eliminate hypoxia. But the group of hinged shellfish called bivalves have an amazing capacity to stem the condition. Lying on the bottom like tiny vacuum units, they constantly pull in water, eat algae called phytoplankton and spew clear water back out.

In the Narragansett, mussels and clams such as the locally renowned quahog do most of this work. But because they live on the bottom, they are themselves susceptible to hypoxia. The result is a double loss: of the animal and a vital self-cleansing mechanism.

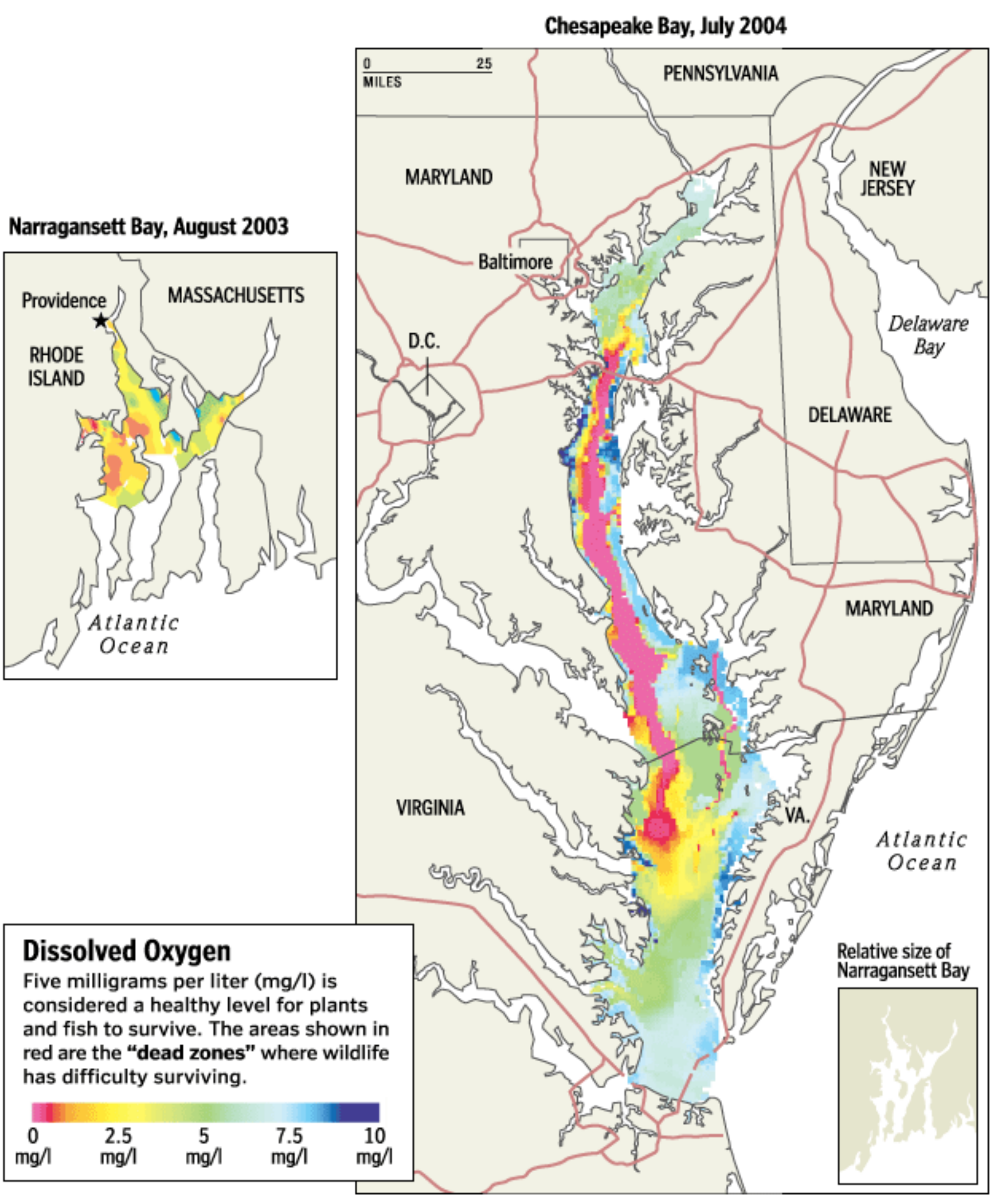
The Chesapeake, the nation's largest estuary, is a premier example of this. Historically, oysters were the dominant shellfish in the bay -- as they were in the Narragansett until the 1930s -- but overfishing and disease have all but killed off the Eastern Oyster. Today, despite decades of restoration efforts, the oyster population remains less than 1 percent of what it was in 1880, the dawn of the region's oyster industry.

Living Water Filter

As oysters feed, they remove algae, sediment and other pollutants - even nitrogen - from the water.



By Patterson Clark, The Washington Post


Chesapeake Bay, July 2004
0
25
MILES
PENNSYLVANIA
MARYLAND
NEW JERSEY
Baltimore
D.C.
Delaware Bay
DELAWARE
MARYLAND
VIRGINIA
VA.
Atlantic Ocean
Narragansett Bay, August 2003
Providence
MASSACHUSETTS
RHODE ISLAND
Atlantic Ocean
Dissolved Oxygen
Five milligrams per liter (mg/l) is considered a healthy level for plants and fish to survive. The areas shown in red are the "dead zones" where wildlife has difficulty surviving.
0 mg/l
2.5 mg/l
5 mg/l
7.5 mg/l
10 mg/l
Relative size of Narragansett Bay

"It's criminal, really," said Roger Newell, professor at the University of Maryland Center for Environmental Science, who studies the impact of oysters. "It's a keystone species -- once it's removed from the environment, that system is irreversibly deteriorated."

Oysters make superior filters for three reasons. They process water at a rate of two to three times that of mussels. The Chesapeake's oysters generally live in high-oxygen shallows and tributaries, where they are less susceptible to hypoxia. And as the oysters feed and excrete, they also remove nitrogen from the water in a process similar to one used by sewage treatment plants.

Newell calculated that at their current numbers, the bay's oysters would need a year to filter its entire volume.

But without enough shellfish around, Newell must rely on computer models to estimate the impact. "This is all educated arm-waving, because you can't go back in time," he said.

That historical view is what Altieri and Witman gained in Rhode Island. Ironically, the pair were investigating an unusual boom in blue mussels in 2001 that local watermen called "a once-in-20-years occurrence," Witman said. The nine reefs they studied covered the equivalent of 229 football fields. Lying open in rows, the creatures gleamed blue-black and red, attracting crabs, sea stars and fish that eat them and live in the reefs. Snorkeling over them, the ecologists could see the reefs through 20 feet of water in a bay where average visibility is about four feet.

Altieri calculated that the reefs were processing the bay's entire water volume once every 20 days, even though they covered less than 1 percent of the bay floor.

Then one day in August, the men saw sea stars and crabs in the reefs climbing higher, searching for oxygen. Altieri noted that dissolved oxygen in the water had plummeted.

Within days, a hypoxic episode triggered by warm weather, low wind and the usual nutrients contributed to fish kills and beach closures around the bay. Two months later, mussels lay scattered like broken pottery on the bay floor, silted over and empty, more than 4 billion of them. Their filtering capacity had dropped by 75 percent.

One reef died entirely. A year later, seven of the other eight were mostly dead, too.

"The magnitude of mortality that hypoxia could cause . . . had never been documented" in the Narragansett, Witman said. "We had the ability to look at effects on individual species and the entire ecosystem." The damage from that one event, they estimated, could take more than a decade to undo.

The study has stocked the arsenals of the Chesapeake's oyster restoration advocates. Virginia and Maryland have spent tens of millions of dollars on oyster restoration and billions on bay cleanup over the past three decades, but they have not significantly curtailed oyster harvests. Meanwhile, the beleaguered industry has turned to a mechanized process called "power dredging" to maximize skimpy harvests, further threatening the oyster population. Some have proposed introducing a disease-resistant Asian species, but environmentalists argue that could have unintended consequences for the bay's battered ecosystem.

"It's very compelling," Maryland's Newell said of the Narragansett report. "The more examples like that we have, maybe we can get people" -- he paused for a short laugh -- "to actually change policies."